

ENVIRONMENTAL ASSESSMENT
OF THE
OPERATION AND MAINTENANCE
OF
STAMFORD HURRICANE BARRIER

STAMFORD, CONNECTICUT

Prepared by



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JUNE 1974

Preface

The purpose of this Environmental Assessment is to provide the basis for an evaluation of the environmental impact of the routine operation and maintenance of the Stamford Hurricane Barrier as a flood control project. Although the project's primary purpose is to prevent tidal flooding, management of the project resources are also of importance.

STAMFORD HURRICANE BARRIER

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I. PROJECT DESCRIPTION

A. INTRODUCTION

1. Location and Authorization

The Stamford Hurricane Barrier (the project) is located entirely within the City of Stamford, Connecticut. The City of Stamford, Connecticut is located in Fairfield County, on the north shore of Long Island Sound, approximately 35 miles east of New York City and 20 miles southwest of Bridgeport, Connecticut. It is adjacent to the town of Darien on the east, Greenwich on the west and covers an area of nearly 38.5 square miles with a total water frontage, including harbors, of approximately 15 miles.

The project provides protection to approximately 600 acres of property below elevation 14.8 feet, mean sea level (m.s.l.). The project was authorized by the Flood Control Act, dated July 14, 1960, Public Law 86-645, 86th Congress. Construction was started in 1965 and completed in January 1969, at an estimated cost of 11.7 million dollars.

B. STRUCTURES

1. General

The project is divided into three principle features:

(a) The West Branch barrier which protects the area between the East and West Branches of Stamford Harbor; (b) the East Branch barrier which is connected to the West Branch barrier and extends across the mouth of the East Branch; and (c) the Westcott Cove dike which protects the residential area of Rippowam Street and skirts Westcott Cove and Cummings Park.

a. West Branch Barrier

The West Branch barrier extends along the east bank of the West Branch from the mouth of Rippowam River to Dyke Park, a distance of 3,450 feet, where it connects with the East Branch barrier. The West Branch barrier includes 1,340 feet of anchored concrete piling wall, 100 feet of cantilevered concrete wall and 1,950 feet of rock-faced earth dike. Top elevation of the West Branch barrier is elevation 17 feet m.s.l. and was designed to contain a still water level of 14.8 feet m.s.l.

Included in the wall portion of the West Branch barrier are intake and discharge structures for cooling water for the Hartford Electric Company plant which has since moved out of the City of Stamford. The structures are no longer operated.

The Dyke Lane pumping station is a reinforced concrete structure containing two 30-inch and three 48-inch vertical propeller-type pumps. The 30-inch pumps, driven by 150 horsepower electric motors, have a total capacity of 100 cubic feet per second (c.f.s.). The 48-inch pumps have a total capacity of 416 c.f.s. and are driven by 500 horsepower motors. The 30-inch pumps are operated automatically, pumping the normal runoff from 197 acres. When the runoff exceeds the capacity of the 30-inch pumps, the 48-inch pumps are started manually.

b. East Branch Barrier

The East Branch barrier extends easterly from the West Branch barrier in Dyke Park across the East Branch, connecting with higher ground on Shippan Point. It includes 2,840 feet of rock-faced earth dike, a 90-

foot navigation gate and the East Branch pumping station, located at the navigation structure. Top elevation of the barrier is 17.0 feet m.s.l. The pumping station contains two 30-inch vertical propeller-type pumps with a total capacity of 100 c.f.s., driven by 100 horsepower motors. The pumps discharge interior runoff entering the East Branch during periods of gate closure.

The East Branch has a contributing interior drainage area of approximately 1200 acres and the harbor has a surface area behind the barrier ranging from 60 to 80 acres. The East Branch pumping station was designed to maintain a harbor elevation behind the barrier below the damage stage of 6.3 feet m.s.l.

c. Westcott Cove Barrier

The Westcott Cove barrier extends easterly from Shippan Point, northeasterly to Iroquois Street, northerly to the head of Halloween Cove and Cummings Park, then easterly to higher ground in Cummings Park. It includes 4,200 feet of rock-faced earth dike, access ramps and parking areas at the Wampanaw and Cummings pumping stations. The top elevation of the dike from the westerly end to the Wampanaw pumping station is 19.0 feet m.s.l. and the remainder 18.0 feet m.s.l.

The Wampanaw pumping station is a reinforced concrete structure housing two 20-inch vertical propeller type pumps, driven by 60 horsepower electric motors, with a total capacity of 50 c.f.s. A four by four foot conduit carries the discharge through the barrier.

The Cummings pumping station is a reinforced structure housing three 30-inch vertical propeller-type pumps, driven by 100 horsepower electric motors and having a capacity of 140 c.f.s. Discharge is carried through the barrier by a five by five foot conduit.

One 18-inch sluice gate and two gate valves, 12 and 6 inches, are located on sanitary sewers that pass through the Westcott Cove barrier. These gates are closed only in the event of hurricanes when the unprotected areas served by city sewers would be evacuated.

C. OPERATION PROCEDURES

Responsibility for project operation is shared by the U.S. Army Corps of Engineers and the City of Stamford. The Dyke Lane, Wampanaw, and Cummings pumping stations are operated by the City of Stamford while the Corps of Engineers operates the East Branch navigation gate and its appurtenant structures and facilities. Operational procedures are coordinated with the National Weather Service which provides information on abnormal tide and weather conditions.

Operating procedures for facilities operated by the Corps of Engineers and the City of Stamford are described in Appendices A and B respectively.

II. ENVIRONMENTAL SETTING

A. DESCRIPTION OF GENERAL AREA

1. Climate and Precipitation

The climate of the Stamford area is variable and temperate, with occasional extremes in temperature and precipitation. Extremes of

either hot or cold weather are rarely of long duration due to the moderating influence of nearby Long Island Sound and the Atlantic Ocean, and variable movements of high and low pressure systems approaching from the west or southwest. The area is exposed to coastal storms, some of tropical origin, that travel up the Atlantic seacoast. Coastal storms during the winter frequently bring rain in the Stamford area rather than snow, which is more common in the more northerly sections of New England. Thunderstorms, either of local convectional origin or associated with a cold front, may occur at any time of the year. High winds, heavy rainfall, and abnormally high tides occur with unpredictable frequency. Hurricanes can be expected at any time from June through October, but occur more frequently in the last three months of this period.

Mean monthly temperatures vary widely from about 29°F in the winter to approximately 73°F in the summer. Temperature extremes range from more than 22°F below zero to more than 104°F in the summer. Mean annual temperature is approximately 51°F. Freezing temperatures are common from late November through March.

Mean annual precipitation in the Stamford area is approximately 45-inches and is fairly well distributed throughout the year. Monthly precipitation of record varies from less than one inch to over 17 inches. Maximum and minimum annual precipitation of record are 63 and 34 inches respectively.

Based on sixty-eight years of record, snowfall at nearby Norwalk averages about 34 inches over the winter season. The snow cover usually reaches a maximum depth in the middle of February.

The Stamford area experiences three general types of storms; continental, coastal and those associated with thunderstorms. Continental storms originate over the United States and southwestern Canada and move in a generally easterly or northeasterly direction. These storms may be rapidly moving intense cyclones or maybe of the stationary type. These are not limited to any season or month, but follow one another at more or less regular intervals with varying intensities throughout the year. Of the coastal storms, tropical hurricanes constitute a very important potential for flood producing precipitation and exceptionally high tides from July to October. Coastal storms of extra-tropical nature differ from hurricanes, primarily in that they originate off the Carolina coastline and their accompanying winds are at lower velocity. These storms, which can produce abnormally high tides, occur most frequently during the autumn, winter and spring months. Thunderstorms may be of local origin or, during summer months, the frontal type.

2. Tides

Two high and two low tides occur each lunar day in the Stamford area with a mean range of 7.2 feet. Mean low water is 3.4 feet below mean sea level and mean high water is 3.8 feet above mean sea level. Spring tides, with an average of 8.5 feet, occasionally will reach elevation 5.7 feet above mean sea level (1.9 feet above mean high

water). The time interval for a complete tidal cycle averages about 12 hours and 25 minutes. Tidal data for Stamford are shown below.

NORMAL TIDES
STAMFORD, CONNECTICUT

	<u>Feet</u>
Mean Tide Range	7.2
Mean High Water (above msl)	3.8
Mean Low Water (below msl)	3.4
Average Spring Tide Range	8.5
Predicted Mean Spring High Water	4.4
(above msl)	
Predicted Maximum Spring High Water	5.7
(below msl)	
Minimum Low Water (below msl)	6.4

3. Topographical and Geological Features

The topography of Stamford is of moderate relief, with elevations ranging from sea level along the coast to a maximum of 560 feet above sea level in the northwesterly portion. Stamford Harbor lies on the seaboard low land at the confluence of the Rippowam River and Long Island Sound and is bounded by Peck Point on the west and Shippan Point on the east. Stamford is also exposed to the Sound by Westcott Cove, a broad, shallow embayment northeast of Shippan Point. Shippan Point, a peninsula, often becomes an island during times of abnormally high tides.

Stamford dramatically shows the effect of its geological past. The harbors, inlets and estuaries, used by the community for commercial and recreational purposes, can be described as drowned valleys - i.e., the water from the ocean (Long Island Sound) has partially filled the valleys formed by the underlying rock and subsequent glacial deposits, making islands out of the old hilltops.

In general, the underlying bedrock is part of what is considered the western crystalline highland of Connecticut. The surface of the bedrock has been broken, grooved and shaped by extreme erosion and the grinding action of glaciers which passed over the area. These were the same historic glaciers that formed, 25,000 to 50,000 years ago, the classic example of a terminal and moraine ice deposit - Long Island Sound.

The ancient gneiss bedrock underlying Stamford is variable and granitized, owing to granitic intrusions during the upper Paleozoic time, and outcrops are abundant throughout the Stamford area. The generally thin overburden consists of bony gravels and sands immediately adjacent to streams with marshy deposits in the narrow, poorly-drained flats between rock ridges, and a thin veneer of till on the sides of hills. The ocean front area, where it is flat, is mostly artificial fill, largely consisting of industrial wastes. Much of the fill overlies marsh mud or peat. In the harbor, there is a depression containing soft organic silts at least seventy feet thick.

4. Vegetative Cover

The Stamford Harbor area is heavily urbanized with industrial, commercial and residential uses in evidence. Consequently, vegetation is relatively sparse, except in recreation areas along the shore.

Estuarine marsh grasses and reeds can be found at various points along the harbor. Further inland, some hardwoods and conifers can be found. Grass has been sown on the barrier wherever it consists of an earth berm. The parks in the area also contain vast expanses of mowed grass with scattered hardwoods and conifers.

5. Fish and Wildlife Species Present

Long Island Sound is characterized by diverse populations of aquatic life. Over 100 species of fin fish have been documented in the Sound. High concentrations of plankton, vast quantities of bottom fauna and large numbers of forage fish are also characteristic of Long Island Sound.

Stamford Harbor, particularly the East Branch, is characterized by the absence of diverse aquatic life. The highly polluted waters of the East Branch allow only such benthic organisms as worms and insects to thrive. Occasionally, eel and bluefish have been seen foraging for food in the East Branch. However, they do not remain long.

Because of the heavily built-up nature of the area, wildlife diversity is low. Bird species in the area include seagull, tern and other shore birds as well as seasonal appearances of songbirds. Habitat for mammalian wildlife is minimal.

6. Socio-economic Conditions

The City of Stamford, with a 1970 population of 108,798, has a strong industrial base with more than 300 companies providing local employment. Manufacturing, employing about 34 per cent of the work force, produces postage meters, tools, fixtures, jigs, bearings, digital computers, electronic equipment and electric household appliances in the durable goods category. In non-durables, the larger employers are in the field of chemicals and cosmetics.

Stamford is close to the New York City metropolitan area and is one of Connecticut's larger cities. It is highly developed for residential, suburban, commercial, and industrial purposes. The City of Stamford is accessible from the major transportation facilities such as the Merritt Parkway, U.S. Rt. 1, the Connecticut Turnpike (Interstate Rt. 95), and the Penn Central Railroad New Haven Division.

7. Water Uses

The waters of Stamford Harbor are used for commercial navigation and recreational boating. Bathing beaches are located on the west side of the West Branch and also in Westcott Cove. Commercial navigation occurring in the East Branch includes the shipping of sand and gravel, and iron and steel scrap. The types of vessels in use consist of sculls, barges and tugs with the largest having a 48 foot beam. Four marinas are located on the East Branch, two of which are behind the navigation gate. During the recreation season, hundreds of pleasure craft pass through the navigation gate daily.

III. ENVIRONMENTAL IMPACT OF THE OPERATION, MAINTENANCE AND MANAGEMENT PROGRAM

A. OPERATION OF THE PROJECT FOR AUTHORIZED PURPOSES

1. Landward Effects

a. Flooding Prevented

The City of Stamford has been subject to losses from storm tidal flooding since its settlement. After the area incurred severe damages from hurricane "Carol" in 1954, a study was initiated to determine the feasibility of a protective barrier for Stamford.

From the start of operation in 1968 up to January 1974, the project has operated 83 times to reduce storm tidal flooding in the city. The estimated benefits derived from the project total \$2,995,000.

As the foregoing suggests, the project has provided considerable flood protection benefits to the developed inland areas adjacent to the harbor. With tidal flood protection as an incentive, however, encroachment into once flooded areas has occurred. While a substantial portion of the area receiving flood protection is highly urbanized, recent sub-division development has taken place, thereby increasing the possibility of future flood damage.

b. Fish Life

The East Branch navigation gate is the only portion of the project which has a direct environmental impact on fish life. The navigation gate is opened most of the time, thus allowing predatory fish to enter the East Branch in search of forage fish. However, when closed, the gate creates a barrier to the movement of fish, thus subjecting these fish to longer than usual exposure to poor water quality.

In some cases, this may result in some fish losses. However, the gate is closed for only short periods, normally 2-4 hours in length.

c. Water Quality

The State of Connecticut has designated the East Branch behind the hurricane barrier a Class SD which is defined as suitable for navigation, power, and certain industrial uses. Waters in this classification are considered suitable for fish migration and are of good aesthetic value. Neither the Corps of Engineers nor the City of Stamford conducts water quality monitoring or data collection programs at the project. No quantitative data are available to assess changes in water quality due to project operation.

The City of Stamford's Sewage Treatment Plant is adjacent to the East Branch. At present, the plant provides primary treatment but is scheduled to provide secondary treatment by October, 1975. The plant's treated effluent is discharged to the East Branch. The settling of solids in the effluent may have adverse impacts on benthic organisms of the harbor and detract from the harbor's recreational and scenic values.

During times of flooding, the project reduces the amount of land that is subject to inundation and erosion, thereby reducing the amount of erodable material entering coastal waters. This reduction lessens the need for costly periodic dredging of the harbor and may reduce harbor pollution and turbidity in the Sound.

d. Commercial and Industrial Uses

Closing of the navigation gate can interfere with commercial and industrial traffic. However, the gate is rarely closed for more than a few hours. Furthermore, the barrier operator notifies all concerned businesses and the Coast Guard when storms are imminent and every effort is made to allow sufficient time for traffic to clear the gate in either direction.

Occasionally, the gate is closed for a day or more for maintenance. Generally, two days advance warning is given to the Coast Guard and businesses so that schedules may be arranged accordingly.

e. Recreational Uses

Recreational boating activities are affected by the project to the extent that the navigation gate, when closed, prevents the passage of boats between Stamford Harbor and the East Branch. The gate is closed only for maintenance and during abnormal tide conditions. However, recreational boating is limited or non-existent during these storm periods, a factor which limits the extent of the project's impact on navigation.

Cummings Park, located in the Westcott Cove area, is separated from the East Branch by the barrier. Recreational facilities include play areas, athletic fields, and walks. The operation of the barrier provides protection for the park. However, it visually isolates the park from the water and breaks up what was once an integrated park into two distinct units.

f. Aesthetics

The cumulative total of the project's diked areas, approximately 11,000 feet, presents a significant visual barrier eliminating a view of the Sound along much of the project and thereby negating much of the area's potential scenic value. Furthermore, approximately 50 percent of the diked portions of the project is protected by rock facing, a condition which some may find less aesthetically desirable than grassed slopes.

It should be noted, however, that the scenic impact of any man-made feature depends upon its relationship to the larger surrounding environment. Unfortunately, much of Stamford Harbor, particularly the area of the project, is characterized by many of the ills afflicting urban harbors of the northeastern United States. Extremely poor water quality, mixed and potentially conflicting land uses, and abundant litter and wash-up debris all contribute to a pattern of deteriorating environmental quality at these facilities, including Stamford Harbor. Any observations or comments of the project's impact on the scenic qualities of Stamford Harbor should be considered in this perspective.

2. Seaward Effects

a. Water Quality

The State of Connecticut has designated the waters of Stamford Harbor seaward of the barrier as Class SC, which is defined as suitable fish, shellfish and wildlife habitat. It is also suitable for recreational boating and industrial cooling and has good aesthetic value.

The State of Connecticut Health Department conducted a bathing beach investigation in 1971. As the study results indicate, the water quality of the project area (seaward) ranges from fair to poor based on coliform bacteria counts. The project has little or no effect on the water quality of Stamford Harbor.

b. Erosion

The project affords no protection from coastal erosion, however, the amount of land on the seaward side of the project is not extensive. Uses on the seaward side of the barrier include marinas, parks, beaches and residential development. Erosion of these areas occurs during severe coastal storms. As noted above, the project may have the effect of reducing the amount of beach building materials from the landward side of the project to replace lost material.

c. Recreational Uses

Much of the land on the seaward side of the project is used for various forms of recreational activity, most of it water-oriented. Beaches, marinas and appurtenant facilities, and promenades with views of the water are among the facilities available. As indicated above, the project offers no protection to these facilities since they are seaward of the barrier.

d. Aesthetics

When viewed from the seaward side of the harbor, the project acts as a physical barrier which prevents an uninterrupted view of the Stamford shoreline. This would be considered a severe adverse impact if the shoreline was in an undeveloped, or natural state, in which case there would have been no need to construct the project. Considering

the current state of development of the Stamford shoreline, i.e. mixed industrial, commercial, and shipping, certain sections of the project's diked areas may actually provide some value by screening some of the blight associated with the shoreline area of the project.

Conversely, diked areas of the project also screen from view a number of opened yard and natural areas of the shoreline, e.g. Dyke Park and Woodland Cemetery, which may have provided shoreline scenic amenities had the barrier not been constructed.

E. CONSTRUCTION AND MAINTENANCE OF PROJECT FACILITIES

Maintenance of the East Branch navigation gate and pumping station is the responsibility of the Corps of Engineers. The remainder of the project which includes the West Branch dike, Dyke Lane pumping station, East Branch dike, Westcott Cove dike and the Cummings and Wampanaw pumping stations are the responsibility of the City of Stamford.

There are no recreational facilities on project land; however, the public is allowed access to view project facilities. While sightseers are permitted to view the operation of the East Branch navigation gate, no provisions have been made to accommodate them. To date, this demand has been minimal.

Wastes generated in the project area are associated with washed up debris from tidal fluctuations and litter from recreational facilities that abut the project. Placement of trash receptacles by the City at their recreation areas might reduce the litter problem.

The control of such disease-carrying vectors as mosquitoes and rodents is presently unnecessary and no maintenance measures have been applied for these purposes.

The control of weeds on rock slopes is the responsibility of the City of Stamford. When necessary, this is accomplished by application of a herbicide. Some other weed control measures may be necessary since continued use of chemical herbicides might affect water quality.

C. MANAGEMENT OF PROJECT LANDS

1. Rules and Regulations

The project facilities are not oriented toward public use; hence, no rules and regulations concerning such use have been promulgated.

IV. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED AS A RESULT OF THE OPERATION AND MAINTENANCE PROGRAM

A. FISH LIFE

Closing of the East Branch navigation gate will create a temporary barrier to fish movement in the East Branch. Predatory fish, entering the East Branch in search of forage fish could be detained during flood control operations. However, the impact would be minimal due to the limited period of operation, generally amounting to only a few hours.

B. WATER QUALITY

Operation of the project reduces the erosion and sedimentation normally caused by inundation during abnormal tides. These sediments include nutrients for aquatic organisms and a reduction in their availability may have an adverse impact on productivity in the nearby water. The extent and exact nature of this impact, however, would be difficult to determine.

C. INTERFERENCE WITH NAVIGATION

Operation of the project has an adverse impact on commercial and recreational boats using the East Branch. When the navigation gate is closed, these boats are forced to remain in the harbor or seek shelter in one of the other coves or marinas. However, the duration of operation is relatively short and adequate warning is provided through a system of navigation light and warning signals (See Appendices A and B).

V. ALTERNATIVES TO THE OPERATION, MAINTENANCE AND MANAGEMENT PROGRAM

A. DISCONTINUANCE OF AUTHORIZED FLOOD CONTROL OPERATION

Discontinuance of flood control operations at the Stamford Hurricane Barrier would subject the City of Stamford to periodic tidal flooding from coastal storms or hurricane resulting in severe flood damage. Hence, the risks of discontinuance of flood operations do not appear warranted.

B. LAND MANAGEMENT ALTERNATIVES

At the present time, the project is being managed primarily as a flood control facility. The nature of the dikes limits their utility for other purposes and precludes their use for recreation due to safety hazards and maintenance considerations.

VI THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The relationship between short-term uses of environment and natural productivity is a complex one. Before this relationship can be understood, however, "short-term uses" and "long-term productivity" must be defined.

For the purposes of this assessment, "short-term uses" are generally those activities in which man interacts with any aspect of the project or its purposes. Thus, at the Stamford Hurricane Barrier, short-term uses include the flood control operations and maintenance. Man's activities in the flood zone are also project related short-term uses.

"Long-term productivity" refers to the natural resource base and its capacity to support and sustain life. Among the natural resource units connected with the project are the overall project site, the flood areas and the tidal estuaries and harbors at Stamford.

The flood control operation of the project is a short-term use of the environment which is of significant benefit to other short-term uses; namely, human development and activity in the flood protected area. However, it has differing effects on the maintenance and enhancement of long-term productivity.

Flood areas which were annually inundated prior to institution of flood control procedures, are no longer subject to flooding and erosion. The productivity of these areas, while not necessarily increased or decreased, can be expected to differ from pre-control conditions.

VII. ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS
OF RESOURCES WHICH ARE INVOLVED IN THE OPERATION
AND MAINTENANCE PROGRAM

There are no irreversible or irretrievable commitments of resources involved in the operation and maintenance program.

VIII. COORDINATION WITH OTHER AGENCIES

The preparation of this environmental assessment was accomplished with input from the following Federal, State and Local Agencies:

Soil Conservation Service, U.S. Department of Agriculture

Connecticut Department of Environmental Protection

Connecticut Department of Public Health

Long Island Sound Regional Study

Stamford Flood and Erosion Control Board

Stamford Harbor Master

Stamford Conservation Commission

Stamford Public Works Department

Stamford Parks and Recreation Department

Zoning Board of Stamford

APPENDIX A

APPENDIX A

STAMFORD HURRICANE BARRIER STANDARD OPERATING PROCEDURE FOR HURRICANES AND COASTAL STORMS

1. GENERAL

Emphasis in this Appendix is placed on duties of the Reservoir Control Center (RCC) and barrier operator for the operation of the navigation gate and East Branch pumping station during coastal storms and hurricanes.

2. REGULATION FOR HURRICANES

Operational functions during regulation periods are divided into "phases" to assure clear delineation of responsibilities and actions to be taken by RCC and the barrier operator as a storm approaches New England. Operational phases for a hurricane are as follows:

a. Phase 1 - Alert. U. S. Weather Bureau (USWB) announces that a hurricane poses a possible threat to southern New England and/or is located north of 30° latitude and west of 65° longitude.

(1) RCC will alert Corps personnel for possible staffing and will arrange to receive further advisories from USWB.

(2) RCC will plot predicted astronomical tides and position and movement of storm.

(3) Chief, RCC may at his discretion staff regulation personnel in NED.

b. Phase 2 - Watch. Hurricane "Watch" announced by USWB for southern New England coast and/or hurricane crosses 35° latitude.

(1) RCC will activate regulation personnel in NED and staff barrier and East Branch pumping station.

(2) Barrier operator will make frequent observation of tides and weather and will transmit same to RCC.

(3) Personnel at the barrier will test equipment that will be needed for hurricane operation.

c. Phase 3 - Warning. Hurricane "Warning" announced by USWB and/or hurricane crosses 38° latitude.

(1) RCC will issue advisory bulletins to USCG concerning probable gate operation.

(2) The barrier operator will transmit frequent observations of tides and weather to RCC for plotting and keeping complete log of operations and data.

d. Phase 4 - Tidal Surge. Hurricane surge is commencing with tide rising and approaching +2.0 msl.

(1) RCC will instruct operator to close the navigation gate at elevation +2.0 msl and start pumps at the East Branch pumping station. Early notification of closure should be made to permit barrier operator to initiate traffic control procedures.

Time permitting, 20 minutes before predicted closure time, the strobeacons at Jacks Island and Lindstrom Point will be increased from 3 to 30 flashes per minute. Three minutes before closure the horn and red neon signs readings "CLOSED" will be turned on at the barrier. The horn will be turned off when the gate is fully closed.

Considerable discretion and judgment must be used in initiating closure if approaching vessels are only a short distance from the barrier and will pass through within a minute or two. The ocean elevation and rate of rise also must be considered in delaying closure for marine traffic.

(2) RCC will issue advisory bulletin to USCG and other local interests concerning gate operation.

(3) RCC will continue to plot tide data reported by the operator and maintain a log of all phases of operation.

e. Phase 5 - Cessation. Tide has receded to bay elevation and is falling.

(1) RCC will instruct operator to open navigation gate and stop pumps at East Branch pumping station.

NOTE: Opening of the gate should be initiated early so the bay elevation will not exceed the ocean elevation by more than 1 foot during the opening period.

(2) The barrier operator will turn on the horn before opening the navigation gate. The horn will continue to operate until the gate is fully open.

(3) The horn will shut off automatically when the gate is fully open. The neon signs will switch to read "OPEN" and the strobeacons will revert back to 3 flashes per minute. The operator will check to make

sure the above items have changed automatically. He also will maintain a complete log of operations.

(4) RCC will advise USCG, with appropriate bulletin concerning opening, and will continue plotting ocean and harbor elevations until ocean has receded to approximately predicted tide level.

(5) If hurricane moves away and is no longer a threat to the southern New England coast, RCC may direct personnel to demobilize. However, if it appears that tides again may be above normal, RCC may continue staffing of the barrier.

(6) Because hurricanes may stall off the coast or return on a threatening path towards New England, RCC may revert at anytime to either a "Watch" or "Warning" phase.

(7) RCC will prepare a report on the operation.

3. REGULATION FOR COASTAL STORMS

a. Phase 1 - Alert. U. S. Weather Bureau announces that a coastal storm off the Atlantic coast poses a possible threat to southern New England.

(1) RCC will alert Corps personnel for possible staffing and will arrange to receive further advisories from USWB.

(2) RCC will plot predicted astronomical tides and position and movement of storm.

(3) Chief, RCC may at his discretion staff regulation personnel in NED.

b. Phase 2 - Watch. Based on Weather Bureau forecasts it is expected that tides will exceed 6.0 feet msl within the next 8-hour period.

(1) RCC will activate personnel in NED and staff barrier and East Branch pumping station.

(2) Barrier operator will make frequent observation of tides and weather and will transmit same to RCC.

(3) RCC personnel will analyze tide and weather data and determine tide stage for gate closure

(4) RCC will issue an advisory to USCG when gate closure is expected.

c. Phase 3 - Operation. Tide reaches established stage for gate closure.

(1) RCC will instruct barrier operator when to close the navigation gate and start pumps at the East Branch pumping station. The gate will be closed

Time permitting, early notification of closure should be made to permit barrier operator to initiate traffic control procedures 20 minutes prior to gate closure. Twenty minutes should be allowed for complete closure. Operation procedures by operator will be the same as in the case of hurricane operation.

(2) RCC will issue advisory to USCG concerning gate operation.

(3) RCC will continue to plot tide data reported by the barrier operator and maintain a log of all phases of operation.

d. Phase 4 - Cessation. Tide has receded to bay elevation and is falling.

(1) RCC will instruct operator to open navigation gate and stop pumps at East Branch pumping station.

NOTE: Opening of the gate must be initiated early so the bay elevation will not exceed the ocean elevation by more than 1 foot during the opening period.

(2) Barrier operator will follow gate opening and traffic control procedures as detailed in cessation of hurricane operation. He will check to make sure the horn is off, the strobeacons reverting back to 3 flashes per minute and the neon lights read "OPEN".

(3) If storm moves away and is no longer a threat to the southern New England coast, RCC may direct personnel to demobilize. However, if it appears that tides again may be above normal, RCC may continue staffing of the barrier.

(4) RCC will advise USCG with appropriate bulletin concerning opening.

(5) Because storms may stall off the coast or return on a threatening path towards New England, RCC may revert to a "Watch" phase.

(6) RCC will prepare a report on the operation.

4. EMERGENCY OPERATING PROCEDURE

a. Failure of communications. In the event that the barrier operator is unable to communicate with the New England Division by normal or emergency methods during the "Warning" phase of a hurricane, the operator then has full authority and responsibility to close the gate when the hurricane surge commences and tide reaches +2.0 feet msl. Similarly, during

a pending operation for a coastal storm the operator has full authority to operate

b. Gate inoperable. If at any time the East Branch navigation gate becomes inoperable, NED will notify the city of Stamford. If the gate becomes inoperable during an approaching storm tide, NED or the barrier operator under the direction of NED will immediately notify the city of the situation and of possible consequences. If the gate becomes inoperable in a closed position the barrier operator will operate the bypass gate as directed by RCC.

BRIEF OPERATING GUIDE

FOR STAMFORD

1. Nonfreezing Temperatures

a. Dry conditions or negligible rainfall

For tides of 6.2 feet or less - no operation

When tides higher than 6.2 feet are expected, operate to keep harbor at or below 5.8

b. Moderate rain

When tides higher than 6.0 feet are expected, operate to keep harbor at or below 5.5

c. Heavy rain

When tides higher than 5.8 feet are expected, operate to keep harbor at or below 5.0

2. Below Freezing Temperatures (28° or Lower)

a. For tides of 5.9 feet or less - no operation

b. When tides higher than 5.9 feet are expected, operate to keep harbor at or below 5.6

APPENDIX B

APPENDIX B

STAMFORD HURRICANE BARRIER CITY OF STAMFORD STANDARD OPERATING PROCEDURE FOR HURRICANES AND COASTAL STORMS

1. GENERAL

This appendix contains the regulation procedures for those portions of the hurricane protection project which are operated and maintained by the city of Stamford.

2. REGULATION DURING HURRICANES

Operational functions during regulation periods are divided into "Phases" to assure clear delineation of responsibilities and actions to be taken as a storm approaches New England. Operational phases for a hurricane are as follows:

a. Phase 1 - Alert. Hurricane is located north of 30° latitude and west of 65° longitude. The city of Stamford will alert all personnel connected with operation of the project and will arrange to receive continuous advisories from the Weather Bureau.

b. Phase 2 - Watch. Hurricane "Watch" announced by U. S. Weather Bureau for southern New England coast. The city will:

(1) Test pumps and sluice gates at Dyke Lane, Wampanaw and Cummings pumping stations

(2) Notify Hartford Electric Company of possible need for gate operation at discharge structure.

c. Phase 3 - Warning. Hurricane "Warning" announced by U. S. Weather Bureau for southern New England coast. The city will:

(1) Mobilize full complement of personnel.

(2) Open sump gates at Wampanaw and Cummings pumping stations.

(3) Open gates into large sump at Dyke Lane pumping station.

(4) Close sanitary sewer gates in Westcott Cove barrier.

(5) Test all equipment which is necessary for operation. Check materials and supplies such as log, report forms, etc.

- (6) Keep log of operations, tide and pond elevations.

d. Phase 4 - Tidal surge. Hurricane surge is commencing and tide elevation is plus 3.0 feet and rising (all elevations are in feet above mean sea level). Operate as follows:

- (1) Start one pump and close bypass gate at both Wampanaw and Cummings stations.
-

- Cummings (6) Keep log of operations, tide and pond elevations.

- (2) Open diversion gate and close discharge gate at Hartford Electric Company discharge structure.

- (3) Operate pumps at all stations as required per schedule (see plate B-3).

- (4) Maintain complete log of operations.

e. Phase 5 - Cessation. Tide receding below elevation plus 4.0 and storm no longer a threat to area. The city will:

- (1) Open sanitary sewer gates in Westcott Cove barrier.

- (2) Open discharge gate and close diversion gate at Hartford Electric Company discharge structure.

- (3) Open bypass gates and close sump gates at both Wampanaw and Cummings stations.

- (4) Stop pumps at Wampanaw and Cummings stations as per schedule.

- (5) When inflow to Dyke Lane pumping station permits, close gates into large sump and revert to normal operation.

- (6) Complete logs of all phases of operation and prepare reports.

- (7) Demobilize except for personnel required for repairs, cleaning up, such as evacuating remaining water in sumps with sump pumps, flushing walls and floors, etc.

- (8) The cessation phase should not be initiated until it is certain that the storm no longer threatens the area. Consequently, if the tide recedes below elevation 2.0 feet msl following a tidal surge operation and there is some question concerning the location and movement of the storm, the city should not initiate the Cessation phase, but should revert to the Warning phase and be prepared to resume operations if necessary.

3. REGULATION DURING COASTAL STORMS

a. Phase 1 - Alert. U. S. Weather Bureau announces that a coastal storm off the Atlantic coast poses a possible threat to southern New England. The city will:

(1) Alert all personnel connected with the operation of the project and follow closely USWB reports on the movement and possible intensification of the storm.

(2) Check time and height of predicted normal high tides.

b. Phase 2 - Watch. Based on Weather Bureau forecasts it is expected that tides will exceed 6.0 feet msl within the next 8-hour period. The city will:

(1) Notify Hartford Electric Company of possible need for gate operation at discharge structure.

(2) Initiate staffing of Dyke Lane, Wampanaw and Cummings pumping stations when tide conditions indicate need.

c. Phase 3 - Operation. Tide rising and expected to reach 6.0 feet msl in 1 hour.

(1) Tide 6.0 feet msl and rising.

Open sump gate, start a pump and close bypass gate at Wampanaw pumping station.

(2) Tide 6.8 feet msl and rising.

Open sump gate, start a pump and close bypass gate at Cummings station.

(3) Tide 7.0 feet msl and rising.

(a) Open gates into large sump at Dyke Lane station.

(b) Simultaneously, close 8 x 8 foot discharge gate and open 78-inch diversion gate at Hartford Electric Company discharge structure.

(c) Operate large pumps at Dyke Lane station per schedule.

(4) Operate pumps at all stations per schedules.

(5) Maintain complete log of operations.

d. Phase 4 - Cessation. Tide recedes to 5.5 feet msl and storm is no longer a threat to the area. Note: This phase should be initiated only after storm surge has receded and storm is no longer threat to the area. If secondary surges do develop, operation will revert to Phase 3.

(1) Close sump gates and open bypass gates at Wampanaw and Cummings stations.

(2) Simultaneously, open discharge gate and close diversion gate at Hartford Electric Company discharge structure.

(3) Rate of inflow permitting, close gates into large sump at Dyke Lane station.

(4) Stop pumps at Wampanaw, Cummings and Dyke Lane stations, as per schedule.

(5) Complete logs of all phases of operations and prepare reports.

(6) Demobilize, except for personnel required for repairs and cleaning up such as evacuating remaining water in sumps with sump pumps, flushing walls and floors, etc.

4. OPERATION DURING NORMAL TIDE CONDITIONS

The small pumps at the Dyke Lane pumping station are normally under automatic operation for discharging normal drainage. When inflow to the station exceeds the capacity of the small pumps and the water level in the sump rises to minus 4.5 feet msl, an alarm will be sounded in the office of the city incinerator. Upon sound of the alarm, the city will dispatch personnel to the Dyke Lane station, to place the larger pumps in operation. The pumps will be operated until conditions permit return to normal operation.

5. REPORTS

Prior to and during the operation of the project for hurricanes or coastal storms, information pertinent to any operation will be entered on a log. The report will include times of gate openings and closings, pumping operations, sump and bay elevations, operational phases, and any other information or observations that would help in describing the entire operation. A copy of the report will be furnished to NED within 48 hours after the operation.

6. EMERGENCIES

Should communications fail between the city and the U. S. Weather Bureau or any unexpected conditions arise that are not covered herein, and the exigencies of the conditions require immediate operation of part or all of the project, the city shall operate in the best and most reasonable manner to protect the city of Stamford and to satisfy all concerned.

